

3/PRTS

10/529718

Attorney Docket #5367-165PUS

JC17 Rec'd PCT/PTO 30 MAR 2005

LIGHT SOURCE MODULE AND METHOD FOR PRODUCING IT

5 The invention relates to a light source module having a plurality of LEDs (LED = light emitting device) connected to a metal carrier in an insulating manner.

A light source module of this type is described e.g. in
10 the published patent application DE 100 51 159 A1.

This patent application claims the priority of German patent application 102 45 945.2, the disclose content of which is hereby incorporated by reference.

15

The German application bearing the application number 102 29 067 which has not yet been published, discloses e.g. arranging an LED in a frame and potting the region between frame and LED with potting composition. In
20 order to obtain a reflector, preferably reflective potting composition is first filled into the region between frame and LED and subsequently complete potting is effected using clear potting composition.

25 This manner of producing a light source module functions without any problems if only one LED is arranged within the frame.

However, if a plurality of LEDs are arranged in a
30 frame, the frame is completely areally connected by the potting composition to the metal carrier on which the LEDs are arranged by means of an insulating layer.

In the event of greatly different temperature loads,
35 the metal carrier expands differently with respect to the frame since the frame is generally not composed of metal and, consequently, the two materials have different coefficients of expansion.

The different coefficients of expansion of these two components mean that the LEDs are subjected to loading, which can consequently lead to failures of individual LEDs or in this way to the destruction of the entire
5 light source module.

Therefore, the invention is based on the object of demonstrating a light source module which withstands even greatly varying temperature conditions.

10

This object is achieved according to the invention by virtue of the fact that the LEDs are surrounded by a frame, potting composition is arranged between frame and LEDs and the frame has expansion joints.

15

By introducing the expansion joints into the frame, it is possible to use the technology disclosed in the patent application 102 29 067 - published after the priority date -, namely the technology of placing a
20 frame onto the LEDs and potting the interspace with potting composition.

The expansion joints may be realized either by means of portions which are kept extremely thin in the frame and
25 can deform in the event of expansion, or else by means of slots extending completely through the frame.

In accordance with a preferred embodiment, the frame is segmented into a plurality of frame parts by expansion
30 joints.

In this case, a frame part preferably has a maximum of four cutouts in which LEDs can be arranged. In the case where the frame is produced from plastic and the metal
35 carrier is produced from aluminum, this number of cutouts per frame part guarantees a high reliability and functionality even in the event of high temperature fluctuations.

The LEDs are arranged in the light source module preferably in a grid, e.g. in a grid of 4.5 mm in eight columns and four rows, and may be used for realizing an LED light source for an HUD system (HUD = Head-up Display) in a motor vehicle.

The segmentation of the frame for producing the light source module is preferably effected at the end of the process chain, i.e. after introduction in the potting composition. This may be done e.g. by means of a sawing device.

Further advantages of the invention are disclosed in the subclaims and also the description of figures below.

In the drawings:

Figure 1 shows a part of the light source module according to the invention in sectional view,

Figure 2 shows a frame for the light source module in the view from above,

Figure 3 shows the section A-A from Figure 2,

Figures 4A and 4B show the frame for the light source module in the view from above and in side view,

Figures 5A and 5B show a carrier with applied printed circuit board for the light source module in the view from above and also in side view, and

Figures 6A and 6B show the frame from Figures 4a and 4b and also the carrier with applied

printed circuit board from figures 5a
and 5b in the mounted state.

Figure 1 shows an LED light source module in partial
5 sectional view.

In the detail illustrated, the light source module has
two LEDs, one LED in each case comprising two
optoelectronic components 1 arranged on a carrier
10 substrate 2.

The carrier substrate 2 is generally composed of a
material exhibiting good thermal conductivity and is in
each case arranged by means of an interposed insulating
15 layer 3 and also a carrier layer 5 on a metal carrier
4, which serves not only as a carrier but also as a
heat sink. The metal carrier 4 is preferably composed
of aluminum or copper in order to obtain a high
dissipation of heat.

20 The insulating layer 3 integrated in the carrier
substrate 2 generally comprises a silicon oxide layer 6
and a silicon nitride layer 7 applied on the silicon
oxide layer 6. The silicon oxide layer is applied on a
25 carrier layer 5 comprising silicon substrate. The
insulating effect is obtained in particular by means of
the silicon nitride and silicon oxide layers 7 and 6,
the silicon substrate 5 essentially serving only as a
carrier material. Conductive metal pads 20 for making
30 contact with the LED are situated on the insulating
layer 7.

Since silicon layers can be applied in extremely thin
fashion and have a good thermal conductivity, these
35 layers are ideal for the electrical insulation of and
the dissipation of heat from the optoelectronic
components 1 via the carrier substrates 2 to the metal
carrier 4.

Arranged between the carrier substrates 2 are printed circuit boards 8 serving for electrically interconnecting the optoelectronic components 1. A wiring 9 is provided for the connection between the
5 printed circuit boards 8 and the optoelectronic components 1.

In order to be able to pot the LEDs and also for the purpose of producing a reflector, a frame 10 is placed
10 onto the light source module, which frame in each case encloses a carrier substrate 2 with emplaced optoelectronic components 1.

The frame 10 is adhesively bonded at the underside to
15 the printed circuit boards 8, thereby enabling the interspaces in which the LEDs are situated to be potted.

In order to obtain a reflector, the frame is first
20 potted with reflective potting composition 11, such as e.g. white silicone or a filling composition with titanium oxide (TiO_2) or else an epoxy resin admixed with titanium oxide particles.

25 The potting is effected to just under the upper edge of the carrier substrate 2, the surface of the reflective potting composition 11 running concavely to the inner edge of the frame 10.

30 In the second step, the interior space is potted with clear potting composition 12, transparent silicone or transparent epoxy resin generally being used for this purpose.

35 As a result of the frame 10 being potted with the reflective and clear potting composition 11 and 12, said frame is connected more or less fixedly to the LEDs.

The frame 10 is generally produced from plastic for cost reasons, thus resulting in large loads with regard to the LEDs in the event of great temperature differences, since the plastic frame 10 expands
5 differently than the metal carrier 4 that is generally composed of aluminum.

In order to absorb these mechanical loads on the LEDs, expansion joints 13 are provided in the frame 10 and
10 can be used to absorb the greatly temperature-dependent expansion of the metal carrier 4 made of aluminum. The expansion joints 13 may be formed as a greatly tapered location in the frame 10, so that, at this greatly tapered location, the plastic of the frame 10 can
15 deform elastically under the occurrence of loading.

The expansion joints 13, as illustrated in Figure 1, may likewise also be formed as a complete separation of the frame 10 at this location. In the case of the
20 complete separation of the frame 10, a separating cut 14 is generally provided in the expansion joint 13, thereby producing separate frame parts 10a and 10b.

Figure 2 shows in a view from above the complete frame
25 10 such as is used e.g. for a light source module for a head-up display system (HUD system) in a motor vehicle.

The frame 10 has thirty-two cutouts 14 in each of which a carrier substrate 2 with at least two optoelectronic
30 components 1, as illustrated in Figure 1, are arranged.

For the head-up display system, for this purpose the light spots are arranged in a grid of 4.5 mm in eight columns and four rows. Polychromatic light spots are
35 obtained by arranging a plurality of optoelectronic components 1 with different colors on a carrier substrate 2.

In order to avoid the possible damage to the LEDs due to great temperature fluctuations and the resulting different expansions of the frame 10 and of the metal carrier 4, the expansion joints 13 are arranged in
5 latticed fashion in the frame 10, so that the frame is subdivided into a plurality of segments by the latticed expansion joints 13. A frame segment in this case comprises a maximum of four cutouts 14.

10 Figure 3 shows the section A-A from Figure 1 through the frame 10. The frame 10 is formed essentially in planar fashion and has pins 15 at its underside by means of which it can be mounted onto the metal carrier 4. Furthermore, mounting holes 16 are likewise provided
15 which can likewise be used for fitting with the metal carrier.

The cutouts 14 are illustrated in cross section in the right-hand part of the section illustrated in Figure 3,
20 said cutouts having small undercuts 17 at the underside, so that the reflective potting composition 11 is also taken up in a positively locking manner.

At the locations of the expansion joints 13, the frame
25 has a trapezoidal cutout on both sides, which cutout may either be chosen such that the thin web already takes up the deformation or, as illustrated in Figure 1, the remaining web is severed by means of a separating cut 14 at this location using a sawing
30 device.

The severing may be effected after the mounting of the frame onto the metal carrier 4 has been concluded and also after the potting of the cutouts 14.

35 The mounting of the frame 10 is schematically illustrated briefly in Figures 4 to 6. Figures 4A to 6A in each case show the view from above, and Figures 4B to 6B show the side view.

- Figures 4A and 4B show the frames described in Figures 2 and 3, and Figures 5A and 5B show the metal carrier 4 with applied insulating and carrier layer and also a flexible printed circuit board 18 arranged thereon with a flexible conductor connection 19, the carrier substrates 2 and also the optoelectronic components 1 being applied on the flexible printed circuit board 18.
- 10 Figures 6A and 6B show how the frame 10 is merely plugged onto the metal carrier 4 with the flexible printed circuit board 18 already applied and is adhesively bonded to the latter.
- 15 The severing of the expansion joints 13 by means of the sawing device may already be effected after this method step or else not until after the potting of the cutouts 14.
- 20 The scope of protection of the invention is not restricted by the description of the invention on the basis of the exemplary embodiments. Rather, the invention encompasses any new feature and also any combination of features, which in particular comprises
- 25 any combination of features in the patent claims, even if this combination is not specified explicitly in the patent claims.